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Planning Aid for Reuse-based Projects

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TITLE: # Reuse Strategy Model:

Planning Aid for Reuse-based Projects

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ABSTRACT

This document can be used as an aid to realistically plan projects whose philosophical basis is intended to be the STARS vision of megaprogramming. The document contains what is known as the Reuse Strategy Model (RSM), which consists of a method for gauging the current state of reuse practice with concurrent identification of goals that support transition to a state closer to the STARS vision. The notion of assessment used in RSM is to characterize what reuse is practiced and supported, not how efficiently or effectively reuse is practiced. Rather it assesses the extent of a transition to domain-specific, reuse-based development both with respect to engineering and management practice and the infrastructure supporting those practices.

RSM is intended to be used in support of project planning. The use of RSM assumes that the project's domain(s) of interest is known, the organization(s) involved is known, and the project has been characterized relative to the STARS Conceptual Framework for Reuse Processes(CFRP). This characterization means that the high level goal of the project can be identified as primarily an enactment of one of the CFRP's reuse engineering process families (asset creation, asset management, asset utilization) or as an enactment of the reuse management process categories (reuse planning, domain selection, infrastructure development, technology exploration, etc.). The method provides an assessment of what the current reuse practice is, identifies a set of possible goals that should be then winnowed to be realistic in terms of resources and project duration, and provides conceptual notions of what could be used as measures to gauge progress against those project goals.

KEYWORDS

Reuse Project

Project Planning

Reuse Planning

STARS Conceptual Framework for Reuse Processes

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1. INTRODUCTION

This document contains a planning aid for reuse-based projects consisting of a set of dimensions to characterize current reuse practice, a set of goals that are reasonable to adopt based on a current characterization, and a suggested process for performing the characterization. This version of the RSM is an improvement of a prototype RSM that was being developed in an expedient manner for near term use by the STARS Demonstration teams in setting reuse goals and choosing metrics for monitoring progress towards those goals. The improvements were made in response to trial usage by the STARS demonstration projects and in response to in-depth reviews by other STARS participants.

1.1 BACKGROUND

With the growing interest in reuse and the publication of the Software Engineering Institute's (SEI) Capability Maturity Model (CMM), it was natural for interest in developing a similar model of reuse practice to emerge. This interest is particularly sparked by the fact that, while the CMM is a model of good software engineering practice, it does not really address reuse. Furthermore, some proponents of a reuse practice model believe it would be best to develop a separate model while others believe it would be best to incorporate reuse practice into the CMM.

The first publicly-available attempt to develop a separate, but compatible model was the Software Productivity Consortium's (SPC) "Mount Reuse" viewgraph [4]. This was not a complete model in any sense since its real purpose was to depict the SPC's approach to reuse relative to the CMM. The viewgraph depicts five increasing stages of reuse maturity as ledges on a mountain side with *adhoc reuse* at the bottom and *systematic reuse* at the top. Each level or ledge is annotated with characteristics of that stage. While only a broad brush at reuse maturity, it at least related one view of good reuse practice to the CMM levels.

The first published model of reuse practice is the Harris Reuse Maturity Framework (HRMF) [2]. This model also has five stages labeled *initial/chaotic, monitored, coordinated, planned and ingrained* with ten dimensions across those stages. The ten dimensions mainly focus on organization and cultural issues such as who instigates the reuse and who plans for reuse. Since its publication, the HRMF has been used to characterize Japanese software factories [5] and has been extended or tailored to fit specific company needs for technology transfer [3].

The STARS notion of a RSM evolved from work on the development of the CFRP. During 1990, the CFRP joint activity team (whose members include representatives from Boeing, IBM, MITRE, PARAMAX, Software Engineering Institute (SEI), and TRW), spent many hours discussing the SPC "Mount Reuse" viewgraph. In working with the viewgraph, the STARS team came to the conclusion that different concerns were being mixed into each layer and that these concerns should be separated into different dimensions of reuse maturity. The team went so far as to develop a "reuse cube" whose three axes were technology maturity, domain stability, and organizational/process maturity. The scales developed for each axis were not identical, with domain stability having three states and organizational/process maturity having more than five states. The team did not reach closure on this material but did conclude that a reuse maturity model would be needed to complement the CFRP in order to provide strategic planning guidelines.

In June of 1992, the SPC held a workshop titled "Reuse Adoption" as part of its DARPA contract for the Virginia Center of Excellence for Reuse (VCOE). At the workshop, the SPC presented a draft RMM partially based on the SEI's CMM concept of identifying key practice areas for each of five levels of capability maturity. An organization advances from one level of maturity to a higher level when the organization is practicing the key areas identified for the current and all previous levels. Based on feedback from the workshop, the SPC rethought its approach and formulated a Reuse

Capability Model, which is described in its Reuse Adoption Guidebook [6].

Approximately in the same time frame as SPC's development of its RCM, the STARS program developed a prototype Reuse Strategy Model to provide focused guidance to the STARS Demonstration teams in their reuse planning. The prototype was explicitly structured to support identifying project goals and metrics to be used in developing a reuse-based strategy that furthers achieving the STARS vision of reuse. The prototype was applied by the STARS demonstration teams on a trial basis and the results were shared with the RSM developers and the other teams. The general conclusion from the trial applications was that the prototype served to focus attention on reuse management and infrastructure issues crucial to project success that are usually obscured by the specific business objectives of the project. The trial usage also resulted in suggestions for improving the prototype with an extended example and a description of a process for applying it.

1.2 PURPOSE

The purpose of this document is to explicate the Reuse Strategy Model in a form that can be used by project planners to set goals for achieving a state of practice compatible with the STARS vision of domain-specific reuse. This vision of reuse is articulated in the STARS *Conceptual Framework for Reuse Processes: Definition* [1] and *Conceptual Framework for Reuse Processes: Application* documents [2].

The RSM is only one of many planning tools to be used in developing domain-specific reuse strategies. Its main purpose is to identify areas in which organization objectives, policies, procedures, and process definitions can be applied to projects in furthering a cost-effective reuse strategy. The RSM assesses what elements of reuse are being practiced and suggests goals and metrics for monitoring progress against the goals whose achievement either adds missing elements or increase the level of sophistication of reuse practiced. The Harris Reuse Maturity Framework can also be used to assess the state of practice and to suggest reasonable goals. The SPC RCM can be used to assess the efficiency and effectiveness of an organization's practice and to identify organizational goals to improve its reuse productivity.

1.3 AUDIENCE

The intended audience for this document is business and project planners whose organizations are transitioning to a domain-specific, reuse-based software development paradigm.

1.4 REFERENCES

1.4.1 Internal References

The following documents, guidelines, and working papers have been used as input to the Reuse Strategy Model Prototype:

[1] Software Technology for Adaptable, Reliable Systems, *STARS Reuse Concepts Volume I - STARS Conceptual Framework for Reuse Processes:Definition*, USAF Materiel Command, Electronic Systems Center, Hanscom AF Base, MA, Paramax STARS-UC-05159/001/00, November 1992.

[2] Software Technology for Adaptable, Reliable Systems, *STARS Conceptual Framework for Reuse Processes:Application*, USAF Materiel Command, Electronic Systems Center, Hanscom AF Base, MA, Paramax STARS-UC-05159/002/00, July 1993.

1.4.2 External References

Various external references have also been used in the on-going evolution of this document:

[3] P. Koltun and A. Hudson, "A Reuse Maturity Model" in *Proceedings of the Fourth Annual Workshop on Software Reuse*, November 1991.

[4] K.V. Bourgeois, "Technology Transfer of Mature Reuse Practice", *Proceedings of the Fifth Annual Workshop on Software Reuse*, October 1992.

[5] Software Productivity Consortium, *Mount Reuse* in reuse-related briefings,1990.

[6] M. Cusumano ed., *Software Reuse in Japan*, Technology Transfer International, Inc., Colorado Springs, CO, 1992.

[7] Virginia Center Of Excellence For Software Reuse and Technology Transfer, *Reuse Adoption Guidebook*, Software Productivity Consortium, Herndon, VA, 1992.

[8] T. Davis, "Toward a Reuse Maturity Model", *Proceedings of the Fifth Annual Workshop on Software Reuse*, October 1992.

[9] P. Fowler and L. Levine, "Towards a Defined Process of Software Technology Transition", *American Programmer*, March 1992.

[10] M.C. Paulk etal., *Capability Maturity Model for Software*, Software Engineering Institute (SEI), CMU/SEI-91-TR-24, DA240603.

[11] W. C. Lim, "The Impact of Reuse on Software Quality and Productivity at the Hewlett-Packard Company", *Proceedings of the Pacific Northwest Quality Conference*, October 1992.

[12] Virginia Center Of Excellence For Software Reuse and Technology Transfer, Domain Engineering Guidebook, Software Productivity Consortium, Herndon, VA, 1992.

[13] V. Basili and D.M. Weiss, "A Methodology for Collecting Valid Software Engineering Data," *IEEE Transactions on Software Engineering*, Vol. SE-10, November 1984.

1.5 RELEVANT TERMINOLOGY

Most of the terms that follow are used in the STARS CFRP definition document, a few are particular to this document. The shared terms use the definition given in the CFRP glossary. Reading the CFRP definition document will amplify and help to clarify the shared terms.

application engineering: The development or evolution of a system to meet particular application requirements. In a domain-specific reuse-based environment this generally involves determining the requirements that the application imposes on the domain assets, identifying suitable candidate assets in the context of the requirements, selecting and tailoring assets to meet the requirements, and integrating the tailored assets into the application system

asset: Any unit of information of current or future value to a software-intensive systems development and/or PDSS enterprise. Assets may be characterized in many ways including as software-related work products, software subsystems, software components, contact lists for experts, architectures, domain analyses, designs, documents, case studies, lessons learned, research results, seminal software engineering concepts and presentations, etc.

domain: An area of activity or knowledge.

domain age: The length of time that the domain has existed.

domain complexity: To what degree do the solutions used to provide various concepts, actions, or functions interact. Reuse engineering for domains of high complexity is more difficult than for domains of low complexity.

domain coherence: To what degree does the domain exhibit variability. Incoherent domains exhibit many, unconnected variations among its design elements while coherent domains exhibit variations with connections to other design elements that allow prediction of impact of change and encoding of rules to ensure consistent design decisions. Highly coherent domains may derive more benefit from reuse in terms of increasing productivity and quality in system development.

domain volatility: How often innovation impacts the solutions used to build systems within the domain.

domain analysis:The process of identifying, collecting, organizing, analyzing, and representing a domain model and software architecture from the study of existing systems, underlying theory, emerging technology, and development histories within the domain of interest.

domain engineering: The development and evolution of domain-specific knowledge and artifacts to support the development and evolution of systems in the domain. Includes engineering of domain models, components, methods, and tools, and may also include asset management.

domain model: A definition of the functions, objects, data, requirements, relationships, and variations in a particular domain.

domain requirements model: The generic requirements and constraints on a domain and systems in the domain. Equivalent to one common interpretation of the term "domain model".

domain architecture: see domain architecture model.

domain architecture model: A set of software architectures generic to a domain that define organizing frameworks for constructing new application designs and implementations within the domain, consistent with the domain requirements model.

domain implementation model: A mapping between the architecture model and a collection of software components and/or application generators; also the implementation assets themselves.

domain-specific reuse: Reuse in which the reusable assets, the development processes, and the supporting technology are appropriate to, perhaps developed for or tailored for, the application domain for which the software is being developed.

enhancement: A change to a system that adds new, extends, or improves functionality. Error correction, robustness, availability, or performance improvements are not enhancements.

fielded system: One that is (was) in use by actual end-users. A fielded system is neither a demonstration nor a prototype.

product-line: An area of business.

reference or standard software architecture: The high level design of a software system or subsystem. Includes the description of each software component's functionality (or result), name, parameters and their types and a description of the components' interrelationships. (See domain architecture model.)

reuse strategy: A strategy for instituting and evolving reuse capabilities to satisfy overall objectives within an organization. The strategy is generally targeted at specific domains.

scope of planning: the organizations, domains, product-lines, products, or assets affected by a particular plan or planning exercise.

2. DESCRIPTION

2.1 OVERVIEW

The reuse strategy model supports selection of reuse goals and progress metrics compatible with the STARS vision of process-driven, domain-specific reuse based development. One assumption underlying the RSM is that although the organization doing the project has adopted that vision as a long term objective, they have not yet realized it. Thus, the RSM assists a project planning team in setting goals that are realistic in terms of the current context of the project yet they also further the transition to a context in which the STARS vision has been implemented.

The RSM synthesizes the CFRP team's previous work on reuse maturity (the "reuse cube"), the Harris Reuse Maturity Framework, the SPC Reuse Capability Model, and the CFRP itself into three parts:

- an abstract model depicting reuse practices and other dimensions,
- self-assessment and goal identification data, and
- process guidelines for self-assessment, goal identification, and strategy formulation.

The *abstract model* is multi-dimensioned and provides the link between assessment results and identification of reasonable goals for reuse adoption and process improvement. The *self-assessment and goal identification data* are applicable across different types and scales of organizations from project-level through enterprise-wide organizations. And, the *process guidelines* provide guidance in formulating short or long term strategies for reuse adoption and improvement that are appropriate to the domain as well as an organization's current strengths and weaknesses in reuse practice.

2.2 ABSTRACT MODEL

The RSM's abstract model is a matrix of five dimensions and thirty four indicators shown in Figure 1. Each dimension separates out or focuses on one aspect of reuse practice. The five dimensions, which make up the column headings (top row) of Figure 1, are:

- Domain Stability (5 indicators),
- Organization Readiness (9 indicators),
- Experience with Domain-specific Knowledge (6 indicators),
- Usage of Technology for Reuse Processes (8 indicators), and
- Business Climate & Reuse Management (6 indicators).

The indicators for each dimension, which are shown as entries in the columns below each dimension of Figure 1, represent different elements or issues of reuse practice with respect to an aspect of development or management practice that the dimension addresses. The entries in each column are not ordered in any particular way, nor is there any relationship among the indicators in one row. Rather, each indicator represents an independent or separable factor of management or engineering practice for reuse-based projects. The assignment of an indicator to a specific dimension is arbitrary and is provided in the interest of clarifying its meaning and breadth. Note that these indicators are measuring the organizational, infrastructural, management, and domain-specific context in which reuse is practiced and that they are not measuring the reusability of the artifacts used or produced by the projects. That is, a relevant indicator might be whether the effectiveness of the asset set used is being measured; the actual measurement of asset set effectiveness would not be relevant. We encourage each organization using the RSM to tailor or add indicators to best meet their particular needs.

FIGURE 1 Indicators by Dimension

1. Domain Stability	2. Organization Readiness	3. Experience with Domain-specific Knowledge	4. Usage of Technology for Reuse Processes	5. Business Climate & Reuse Management
1.1 Domain Age	**2.1** Motivation for Reuse	**3.1** Experience with building of systems within this domain	**4.1** Domain Modeling Technology Used	**5.1** Costing/ Pricing
1.2 Domain Volatility	**2.2** Scope of Planning for Reuse	**3.2** Experience with domain model	**4.2** Asset Development Technology Used	**5.2** Legal
1.3 Domain Model(s) Existence	**2.3** Identification of Reuse Opportunities	**3.3** Experience with reference or standard architecture	**4.3** Asset Management Technology Used	**5.3** Contractual
1.4 Standard or Reference Architecture Existence	**2.4** Management Commitment to Reuse	**3.4** Experience with set of domain components	**4.4** Asset Qualification Technology Used	**5.4** Domain Management
1.5 Supported off-the-shelf components available	**2.5** Level of Reuse Advocacy	**3.5** Effectiveness of domain asset set	**4.5** Asset Classification/ Cataloging Technology Used	**5.5** Domain Support
	2.6 Awareness/ Commitment to Process	**3.6** Effectiveness of domain asset classifications	**4.6** Asset Identification/ Retrieval Technology Used	**5.6** Domain Learning
	2.7 Reuse Accountability/ Effectiveness Measurement		**4.7** Asset Tailoring/ Integration Technology Used	
	2.8 Training for Reuse		**4.8** Integration of Tools with Processes	
	2.9 Reuse Process Improvement			

2.3 SELF-ASSESSMENT AND GOAL IDENTIFICATION

The self-assessment questions and goal identification data are collated by indicator. The data for each indicator is collected in a matrix called the Indicator Table. Each Indicator Table contains an assessment question, a scale that represents expected responses to the question, a set of possible goals, questions that detect if the transition towards a specific goal is already in progress, and a set of descriptions of metrics for measuring progress against goals. The table is designed to support a simple, uniform process for evaluating each indicator and identifying relevant goals and metrics. Before evaluating an indicator, it is assumed that the project, the organization(s) involved, and the domain or product-line is known. Then, the procedure for indicator evaluation consists of assigning a scale value to the assessment question and then using that value to read possible goals, find the tests for transitions already in progress, and select metric descriptions from the table.

2.3.1 Description of Indicator Data

SCALE AND GOALS

Each scale consists of a set of discrete values, where one value is the worst case and the rest are ordered as to improving or more sophisticated cases. We can think of the attainment of a higher scale value as a transition from one case to the next and associate a *goal* with each transition. Further, we can associate a *question* with the transition that indicates whether the transition has already begun and *metrics* with the transition that can be used to monitor its progress. For instance, the *Domain Model(s) existence* indicator on the "Domain Stability" Dimension has five scale values. The goal for transitioning from the scale value "Domain Model does not exist" to the next higher value is *GOAL: Completed domain modeling effort with domain model, vocabulary, and taxonomy.* The question that would indicate that the transition was already in progress is *TRANSITION QUESTION: Are there any on-going domain modeling efforts whose results are available to the organization?*. The metric that would monitor whether progress is being made is *METRIC: Status reports about the progress in domain modeling show definition of a domain model, taxonomy, and vocabulary and representation of the information in a computer-processable form or show validation of the domain model, taxonomy, or vocabulary by domain experts.* This GOAL/TRANSITION/METRIC approach is derived from the Goal/Question/Metric work reported by V. Basili [13] and others.

TRANSITION QUESTION

Each transition from a current indicator assessment rating to the next higher scale value represents a candidate reuse goal. That is, if the rating is the worse case and there are two more scale values, the goal in the same row as the worst case and the goal in the same row as the next scale value are both candidate reuse goals. There are no goals listed for the highest scale values on the assumption that when a highest value is reached the improvement objective will switch from achievement to sustainment or effectiveness.

Each answer to a transition question supports prioritization of the associated candidate goal since prioritization is one activity that should be part of selecting and formulating the specific goals into a project's plans, The transition question is provided to support making a choice whether to:

- emphasize a transition in progress by giving it high priority,
- assume that a transition in progress will occur without extra effort by giving it low priority,
- or to instigate a transition that is not in progress by giving it high priority.

METRIC DESCRIPTIONS

The metrics associated with each candidate goal generically describe the type of project measures that may be used to track progress in achieving the goal. It is expected that for each goal selected for a project, the broad descriptions will be adapted to project needs and context. These metrics can be adapted by refining metrics already in use within or by defining new metrics that fit the management approach of the organization(s) involved.

The data for each indicator is collected into separate subsections 3.1.1 through 3.5.5. Subsections 3.1, 3.2, 3.3, 3.4, and 3.5 each contain the indicators for one dimension. The subsection numbers are of a form *3.x* or *3.x.y*, where the *x* corresponds a column (dimension) in Figure 1 and the *y* corresponds to a row. Thus, *x.y* corresponds to one cell in the matrix of Figure 1 and represents one indicator. Each subsection contains a table that lists the assessment question for the indicator and contains a matrix that shows the scale values, goals, transition questions, and metrics. Notes that assist in answering the assessment question or in evaluating the candidate goals with respect to business objectives appear at the bottom of the table. The Goal-Transition Question-Metrics for realizing the next case are arranged so that they appear in the same row with the current case. An explanation of the format for the indicator tables is given in the following section (2.3.2).

2.3.2 Indicator Table Format

ASSESSMENT QUESTION (1)				
SCALE VALUE (2)		GOAL (3)	TRANSITION QUESTION (4)	METRIC (5)
A	**WORST CASE**	**GOAL TO EFFECT TRANSITION TO NEXT CASE**	**QUESTION THAT CHECKS WHETHER TRANSITION ALREADY IN PROGRESS**	**METRICS THAT INDICATE PROGRESS AGAINST GOAL**
B				
C				
D				
E	**BEST CASE (6)**	**(7)**		

NOTES:(8)

==========

(1) Assessment question whose response should fall into one of the scale values -- see (2).

(2) Column of partially ordered scale values

(3) Column of goals, the goal in the same row with the assessed scale value is the most likely next case the organization can strive towards. However, any goal in succeeding rows is also reasonable.

(4) Column of transition questions. Positive response means the process of transitioning to next case has already begun.

(5) Column of progress metrics. The goal, transition question, and metric in the same row belong together.

(6) BEST CASE may be best case but business and organizational constraints may make a previous case better. BEST CASE may also not be best if the scale values are truly partially ordered, that is, it may not be clear that the best case is a more mature or more effective practice, it may just be more sophisticated.

(7) This area is blank because it is unknown what would be an improvement to practice once this case is reached. What should occur is that goals are identified to sustain the case or to make its practice more efficient and/or effective.

(8) This is explanatory material including definitions, heuristics, etc.

2.4 RSM APPLICATION PROCESS GUIDELINES AND HEURISTICS

2.4.1 Application Notes

A detailed process description for applying the RSM to a project can be found in section 4. That process description follows this broad outline of steps:

Step 1:. Determine organization(s) and domain of the project and characterize primary project goal with respect to CFRP families and/or idioms.

Step 2: Conduct assessment and goal identification for each indicator.

Step 3: Evaluate and prioritize identified goals relative to project context and constraints.

Step 4: Select highest priority reuse goals, tailor progress metrics, and integrate into project plans.

These steps can be carried out in a range of management styles from hierarchical to a team of peers. The assessment agent may be a single individual or a group. Regardless, the assessor(s) must have read the STARS CFRP definition document and be somewhat familiar with the concepts and technology supporting domain-specific reuse. It is recommended that group assessment be guided by two facilitators -- one to provide on-the-spot expertise regarding domain-specific reuse as articulated in the CFRP and one to record assessments, rationale for ratings, and other issues that arise. This latter recommendation comes from trial application of the RSM by the STARS demonstration teams. Note that even a single assessor may find it useful to record rationale and other issues raised during assessment.

One issue that can arise, if the assessment is a team effort, is the varying perceptions of the members from their roles as managers, engineers, etc. To alleviate the disparate viewpoints, we suggest that the primary goal of the project being assessed be characterized relative to the CFRP families and/or idioms. The primary objective of the project should be identified as asset creation, asset management, asset utilization, reuse planning,reuse enactment, reuse learning, reuse management, or reuse engineering. This characterization can then be used as the perspective (role) for resolving conflicts in ratings from different individuals.

The objective of **Step 1** is to set the context for the assessment and plan. If multiple organizations are involved, it will be necessary to decide if the ratings are to be the weakest, strongest, or composite, where composite means some qualitative mid-point among the organizations. Choosing the weakest would allow assignment of individual goals to particular organizations, while choosing the strongest or composite has least leverage in stimulating a transition.

Using a product-line instead of a domain is possible as long as "product-line" is consistently substituted for "domain" in the text of each indicator. If a product-line is used, consideration should be given to repeating the assessment of the *Experience with domain-specific knowledge* dimension for each domain in the product-line. Such assessments can be used to support make vs. buy decisions in planning the product-line strategy.

The objective of **Step 2** is to develop the assessment and identify possible goals using this basic pattern of steps:

Step 2.1: Rate each indicator relative to the fixed, given scale along with the rationale for the

choice of scale value.

Step 2.2: Use the rating of each indicator as an index into a table of appropriate goals for improving that rating.

Step 2.3: Use the transition questions to determine if there is effort already being applied towards those goals.

Step 2.4: Use the same table to identify measures of progress for each goal.

Step 2.5: Use notes at the bottom of each table and other heuristics found in the process description to check for consistency and to identify redundancy among the set of goals identified.

The indicators can be evaluated in any order but it is suggested that all for one dimension be evaluated before the indicators for another dimension are evaluated. The order in which the dimensions are evaluated should also be chosen at the convenience of the assessment agent(s).

The scale values have all been assigned a letter rather than a number precisely to actively discourage manipulation of ratings into numerical scores (sums, averages, medians, etc.). The scale values are discrete which means that fractional ratings are meaningless. Either the particular practice, process, or concept has been realized or it hasn't. There is some utility to making statements on the order of "*X* percent of the organizations have realized the best case while *Y* percent are still at the worst case." as a justification to placing a high priority on the organizations contributing to the *Y* percent to realize improvement on that particular indicator. Further, there is no meaning to summing or averaging indicator ratings within a given dimension or over all the dimensions. The indicators are to be used to identify the weaknesses with respect to domain-specific, reuse-based development of a designated team doing a specific project within a domain or product-line so that the weaknesses can be addressed in a systematic way. Use of the RSM during system acquisition to compare competitors would be gross misuse since there is no proven correlation currently between particular reuse practices or technologies and either project productivity or product quality. There is only conjecture and some anecdotal evidence.

The objective of **Step 3** is to evaluate the set of goals identified in Step 2 relative to project and organizational constraints. Availability of resources, limitation of authority, or organizational directives can be used to guide the prioritization.

The objective of **Step 4** is to determine what set of goals should be included in the project plan and to integrate them into the actual plans and strategies. This involves commitment by the project team and implementation by management for monitoring and responding to the progress metrics defined for those goals. It is expected that the progress metrics for the project goals will be tailored and precisely defined for the organization and project context. Tailoring involves unambiguous definition of the measures to be collected as well as devising the means and schedule by which the measures will be collected, reported, and reviewed.

2.4.2 Consistency and Redundant Checks

Some of the strategic elements are closely related and in performing Step 2.5, the evaluation of candidate goals, consideration should be given to relationships of precedence and similarity. As an instance of precedence, it would not be possible to set a goal for the organization to gain experience applying the reference architecture for the domain if one does not exist. In other cases, some goals are identical or very similar. These cases may warrant treatment as high leverage or priority goals with one among the similar ones selected if resource limitations are important factors in planning.

Table 1 shows precedence relationships among the goals. Table 2 shows what goals are identical and Table 3 shows what goals are very similar. All these tables name goals with identifier of form *d.i.s*, where *d* is the dimension number, *i* is the indicator number for the dimension, and *s* is the scale letter. A value *x* means all scale values for that indicator. The *d.i* numbers appear in Figure 1, as the last 2 numerals in the subsections of Section 3, where the indicator tables are. The s letters appear in the scales of the indicator tables.

Table 1 Precedence Relationships Among Goals

Prerequisite Goal	Dependent Scale Values
1.3 (Domain Model Exist)	3.2x
1.4 (Reference or Standard Architecture Exist)	3.3x
1.5 (Domain Asset Set Exist)	2.7x, 3.4.x, 3.5x, 3.6.x,5.1B, 5.1C
4.5b-d (Using tool to manage assets)	3.6x

Table 2 Identical Goals

1.2A = 1.2B
2.1B = 2.3A
4.2A = 4.2B
4.3C = 4.5B

Table 3 Extremely Similar Goals

3.1A, 3.2A, 3.3A, 3.4A
3.1B, 3.2B, 3.3B, 3.4B
3.1C, 3.2C, 3.3C, 3.4C
4.3.B, 4.5A

3. DIMENSIONS AND INDICATORS

3.1 DOMAIN STABILITY DIMENSION

The intent of assessing the stability of the relevant domain is to be able to provide some data about the efficacy of investing in the creation of domain models, reference architectures, software assets, and tools and organizational changes to manage and utilize the domain engineering products. There are separate indicators for domain models, reference architectures, and off-the-shelf components since development of components may arise before development of a reference architecture or domain model; and, a reference architecture may arise before a domain model is developed and encoded.

If the project's primary goal is asset creation, asset management, or asset utilization, we assume that the answers for these indicators are readily available because they were addressed during reuse planning. For these projects, evaluation of the indicators serves as a review of the domain status. For other projects (reuse planning, reuse learning, reuse management, reuse engineering), evaluation of these indicators is a reminder that knowledge about the domain (or product-line) status is critical to effective planning and management. Gathering and evaluating various aspects of this knowledge are the goals of the CFRP reuse process categories titled *Reuse Assessment, Direction Setting,* and *Domain Selection* (see CFRP section 3.1.1).

For government organizations that primarily procure systems or government organizations that primarily develop systems, the domain stability indicator ratings impact strategic decisions oriented towards reducing risk, and ultimately cost, by encouraging standardization of domain models and architectures through participation in standards efforts or by funding contracts to develop industry-wide standard models and architectures.

For defense contractors or other commercial firms, the domain stability indicator ratings impact strategic decisions oriented toward creating or sustaining a competitive edge by developing domain solutions for standard hardware, process, or software architectures and participating in standardization efforts in the domain.

3.1.1 Domain Age Indicator

ASSESSMENT QUESTION: How long have software systems existed that use this domain?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	0-4 years - new	None	None	Time-controlled
B	5-9 years - maturing	None	None	Time-controlled
C	> 9 years - mature			

NOTES:
(a) The division into three scale values is very arbitrary. This scale should be tailored to the maturation rate of the particular business area under consideration. There are no specific project goals listed but if the project under consideration has the main goal of *reuse planning, reuse learning, or reuse management*, appropriate goals could be setting up projects to experiment in or trial use assets in the domain.
(b) There may not be sufficient domain expertise built up to allow domain analysis and modeling until the scale value of *B* is reached.
(c) If the scale value is *B*, less resources and time may need to be devoted to studying legacy systems. Instead more effort may need to be devoted to interacting with potential customers in order to gather requirements and constraints.
(d) If the scale value is *C*, a rating of the *domain volatility* indicator becomes important. If the domain is mature and the domain volatility is low, the domain may be ripe for radical innovation. The implication of such a situation for a project whose main goal is *asset utilization* is to alert the developers that a new system may become obsolete in a shorter time than normally expected. The implication for other types of project is that extra attention should be devoted to domain forecasts. This information can be used to evaluate strategic decisions such as whether to pursue innovation or to postpone investment until innovation occurs.

3.1.2 Domain Volatility Indicator

ASSESSMENT QUESTION: How often are enhancements to fielded systems deployed?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Technology innovation impacts at least once per 0.5 years	A standard, adaptable architecture or set of interfaces is used for all systems in this domain	Is there an ongoing effort to standardize an architecture or interfaces for this domain?	Status reports from the standardization efforts show progress in definition of standard architecture or interfaces and in their validation
B	Technology innovation impacts at least once per 1 year	Same as above	Same as above	Same as above
C	Technology innovation impacts at least once per 2 years	Same as above	Same as above	Same as above
D	Technology innovation impacts at least once per 4 years	Same as above	Same as above	Same as above
E	No evidence of impacts from technology innovation			

NOTES:
(a) The intent of this indicator is to determine how vulnerable the domain is to technical innovation. Analysis of market factors such as mission suitability, customer demand, etc. and analysis of domain complexity or coherence should be conducted as part of *domain selection* (see CFRP section 3.1.1).
(b) A fielded system is one that is (was) used by actual end-users.
(c) It may be futile or unwise to stifle technology innovation. But, interface standardization, message-based or layered architectures, and other design techniques can facilitate managing the impact of innovation as long as the interfaces or architecture can predictably be adapted. Note of caution: architecture standardization may be premature for domains whose age rating is *new*.
(d) Enhancements include hardware, interfaces, feature/functionality extension. Enhancements do not include bug correction nor robustness, availability, or performance improvements.

3.1.3 Domain Model(s) Existence Indicator

ASSESSMENT QUESTION: If a domain model exists, for how many years have fielded systems been built using it?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Domain Model does not exist	Completed effort resulting in domain model, vocabulary, and taxonomy.	Is there any on-going domain engineering effort?	Status reports show progress of domain modeling or show validation of same by domain experts
B	Fielded systems using domain model do not exist	Implement (relevant part of) fieldable system using domain model	Are there any applications, which are expected to be fielded in the near term, currently under development using the domain modeling products?	Status reports from application development show usage of domain modeling products. Usage may be counts of domain product (elements) considered or used.
C	For 0-4 years	Domain model identifies most of needed commonality and variability	Is feedback from developers being used to improve domain model?	Status reports from applications developments show decreasing amount of unique development.
D	For 5-9 years	Domain model identifies all of needed commonality and variability	Is feedback from end-users being used to improve domain model?	Status reports from applications developments show negligible amount of unique development.
E	For > 9 years			

NOTES:
(a) The intent of this indicator is to determine if this is a well-understood domain where the domain knowledge has been encoded in a form usable by non-experts. This indicator supports decisions of "make vs. buy" decisions for *asset utilization* projects and "invest in development vs. acquire as off-the-shelf solutions" for *reuse planning* projects (see CFRP section 3.1.1).
(b) A fielded system is one that is (was) used by actual end-users.
(c) Note of caution that counts or percentages based on usage of domain engineering products measure effectiveness and completeness of domain engineering effort **or of the library managing its products.**

3.1.4 Standard or Reference Architecture Existence Indicator

ASSESSMENT QUESTION: If a standard or reference architecture exists, for how many years have fielded systems been built using it?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Domain Reference or Standard Architecture does not exist	Obtain domain reference architecture with definitions of functionality for its elements, the interfaces among the elements, architecture usage principles, and, possibly, a mapping between elements and requirements.	Is there any on-going domain architecture development effort?	Status reports progress of architecture development or show validation of same by domain experts
B	Fielded systems using Reference or Standard Architecture do not exist	Implement fieldable system using domain reference architecture	Are there any applications, expected to be fielded in the near term, currently under development using the architecture products?	Status reports from application development show usage of products. Usage may be counts of architecture product (elements) considered.
C	For 0-4 years	Architecture accommodates most of needed commonality and variability	Is feedback from developers being used to improve architecture?	Status reports from application developments show decreasing amount of unique tailoring.
D	For 5-9 years	Architecture accommodates all of needed commonality and variability	Is feedback from end-users being used to improve architecture?	Status reports from application developments show negligible amount of unique tailoring.
E	For > 9 years			

Notes:(a) The intent of this indicator is to determine if this is a well-understood domain where the design knowledge has been encoded in a form usable by non-experts. This indicator supports decisions of "make vs. buy" decisions for *asset utilization* projects and "invest in development vs. acquire as off-the-shelf solutions" for *reuse planning* projects (see CFRP section 3.1.1).
(b) A fielded system is one that is (was) used by actual end-users.
(c) Note of caution that counts or percentages based on usage of domain engineering products measure effectiveness and completeness of domain engineering effort **or of the library managing its products**.

3.1.5 Supported, Off-the-shelf Components Available Indicator

ASSESSMENT QUESTION: Are there any commercial or internally-managed collections of assets available that support a domain model or a (defacto) standard or reference architecture for this domain?				
	SCALE VALUE	GOAL	TRANSITION QUESTION	METRIC
A	Set of Domain Assets does not exist	Gain access to commercial or internally-managed collection of assets that supports a (defacto) standard or reference architecture or domain model.	Is there any on-going internal domain engineering doing software asset creation for this domain or is a there an announcement by a commercial firm of intent to market a set of assets that supports the reference architecture or domain model?	Status reports from an internal domain engineering effort show progress towards: asset set creation, identification of, mapping to domain model and/or architecture, quality and correctness evaluation of assets, and definition of usage principles.
B	Fielded systems using domain assets do not exist	Implement fieldable system using set of assets and domain reference architecture.	Are there any applications, expected to be fielded in the near term, currently under development using the domain asset set?	Status reports from application development show usage of products. Usage may be counts of assets considered.
C	For 0-4 years	Asset set accommodates most of needed commonality and variability	Is feedback from developers being used to improve set of assets?	Status reports from application developments show decreasing amount of unique development of components.
D	For 5-9 years	Asset set accommodates all of needed commonality and variability.	Is feedback from end-users being used to improve set of assets?	Status reports from application developments show negligible amount of unique development of components.
E	For > 9 years			

Notes:
(a) The intent of this indicator is to determine if this is a well-understood domain where the design solutions been encoded in a form usable by non-experts. This indicator supports decisions of "make vs. buy" decisions for *asset utilization* projects and "invest in development vs. acquire as off-the-shelf solutions" for *reuse planning* projects (see CFRP section 3.1.1).
(b) A fielded system is one that is (was) used by actual end-users.
(c) Note of caution that counts or percentages based on usage of products measure effectiveness and completeness of architecture effort **or of the library managing its products.**

3.2 ORGANIZATION READINESS DIMENSION

All of the assessment questions and indicators for this dimension focus on organizations. Thus, it is necessary to define the scope of the organization being assessed before answering the questions. However, the organizational scope can vary from as broad as the industry for X Windows user interfaces to as narrow as one particular project team.

Most of the indicators in this dimension are taken from the *Harris Reuse Maturity Framework (HRMF)*[3]. The revisions are basically rewordings to remove implementation biases or to broaden the scope to include organizations that acquire systems. For instance, the HRMF Metrics dimension has been rewritten as the *Reuse Accountability / Effectiveness Measurement* Indicator and the assessment scale no longer is predicated on an assumption that integrated, automated support for reuse metrics collection is the "best case."

Most of indicators in this dimension use a scale devised as a pattern of improvement that is a borrowed partially from the technology transition commitment curve [9] and from the software process improvement maturity classification [10]. To wit:

- Unaware/Discouraged
- Understood/Neutral
- Trial use/Workgroup encouraged/Trial use
- Organization encouraged/Required
- Institutionalized/Ingrained.

3.2.1 Motivation for Reuse Indicator

ASSESSMENT QUESTION: What sort of accountability measures does the organization use to motivate an individual to practice reuse?				
	SCALE VALUE	GOAL	TRANSITION QUESTION	METRIC
A	Discouraged	Remove individual performance evaluation criteria that discourage reuse	Are performance criteria being defined or revised?	Performance criteria definitions/ revisions show removal of metrics that reward creation (e.g. new lines of code written)
B	None/ No Individual awareness	All individuals have been introduced to general reuse concepts	Is the organization planning any training seminars on reuse?	Attendance lists from training sessions show increasing participation level of organization
C	None/Individual Awareness	Performance metrics that track reuse by individuals are collected	Are reuse-specific performance criteria being defined or revised?	Performance criteria definitions show inclusion of reusage metrics that report on use of reusable assets or participation in domain quality improvement efforts
D	Individual Encouraged	Performance metrics showing reuse are used to reward individuals (may ultimately be counterproductive)	Are the procedures for performance evaluation of individuals being revised to use reusage metrics ?	Performance evaluation procedures show use of individual reusage metrics
E	Required	Performance metrics showing reuse are used to reward workgroups	Are the procedures for performance evaluation of groups being revised to use reuse-specific performance criteria ?	Performance evaluation procedures show rollup of individual reusage metrics into group reusage metrics
F	Ingrained			

NOTES: (a) The intent of this indicator is raise the issue of individual accountability with respect to reuse. The individual may fill a role from executive through manager to technician. Many other contextual factors such as policies or process definitions of the organization or specific, contractual conditions can also constrain or discourage reuse. Some of these are addressed by other RSM indicators. Analysis and examination of organizational processes may reasonalbly have an objective to ferret out others.
(b) Reusage metrics report on use of reusable assets or on participation in quality improvement efforts for a domain.

3.2.2 Scope of Planning for Reuse Indicator

ASSESSMENT QUESTION At the highest level, who takes responsibility for planning to utilize reusable assets?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	No one	Individuals plan for reuse of their own products.	Are there unsolicited requests to attend reuse workshops and training?	Training expense reports shows attendance at reuse workshops, etc.
B	An individual	Lifeycle models, processes, and example plans used by the workgroup include goals for reuse.	Is there on-going process improvement effort for the workgroup and is it informed about reuse?	Status reports from the process improvement effort show training in reuse or adoption of reuse concepts.
C	A workgroup	Goals for reuse appear in project plans.	Is an on-going domain engineering project planning to produce products that include processes, project life cycle models, plans, and other project management guidelines?.	Status reports from the domain engineering project show progress towards definition of processes, project life cycle models, plans, and other project management guidelines.
D	A project team	Goals for reuse are provided from domain management as input to project planning, pre-proposal activities, or pre-RFP activities.	Are there plans to formulate a domain management plan?	Status reports show: formation of team to create plan, draft plan, acceptance of plan.
E	A Domain management team/manager	Goals for reuse are coordinated across domains.	Has responsibility for a specific set of domains been delegated?	Guidelines for requests for resource commitments require domain rationale and benefit to other than requesting organization.
F	Executive management team/manager			

Notes:
(a) The intent of this indicator is to determine the highest level in the organization at which planning for reuse occurs.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.2.3 Identification of Reuse Opportunities Indicator

ASSESSMENT QUESTION: What individual or workgroup recognizes opportunities to utilize reusable assets?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	No one	All individuals have been introduced to general reuse concepts	Is the organization planning any training seminars on reuse?	Attendance lists from training sessions show increasing participation level of organization
B	Individual	Project development processes include steps to identify potential use of reusable assets	Are definitions of project processes and guidelines being revised to reflect possible use of reusable assets?	Status reports show inclusion of process steps to identify, evaluate, and integrate candidate reusable assets
C 1	Grassroots -- within workgroups and project teams after project initiated	Pre-proposal or proposal activities include discussion about ways to lower costs among executives evaluating or planning different opportunities.	Has management been given briefings on potential or realized benefits from reuse?	Proposal summaries for internal consumption show intent to lower project costs through reuse.
C 2	Serendipitous -- by fortuitous, accidental cooperation among project managers	Project/ Program initiation processes include steps to identify potential use of and cost/benefit from reusable assets	Are definitions of project planning processes and guidelines being revised to reflect possible use of and evaluate cost/benefit from reusable assets?	Status reports from the process definition efforts show progress towards defining processes to identify and evaluate reuse opportunities
D	Project initialization	Domain strategies identify high leverage potential uses of reusable assets	Are processes for domain planning being defined or being revised to consider reuse?	Status reports from the process definition efforts show progress towards defining domain planning processes or show that the revised strategic planning criteria consider reuse
E	Domain directed			

Notes:
(a) The intent of this indicator is to determine whether opportunities for reuse are evaluated with respect to an organization's strategy for and strengths in the domain. We do not believe that the

Grassroots and *Serendipitous* cases can be properly ordered along the scale ; they are labeled C1 and C2 respectively. Some organizations may find it useful to replace this indicator with two, where one has a perspective of a non-management member of a project team and the other indicator has the perspective of management. In that case, the scale for non-management might be: no one, individual, team at own initiative, team as part of defined development process,domain-directed; and, the scale for management might be: no one, individual manager at own initiative, serendipitous (accidental cooperation), planned for during project initiation, domain-directed. The various aspects these scales are trying to elicit are whether reuse opportunities are recognized by someone or some team on it own initiative, whether defined project (non-planning) processes direct that reuse be considered, whether planning for reuse is planned for or happens accidentally. The " best of all possible worlds" may be that *B, C1, D*, and *E* are true simultaneously.

(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.2.4 Management Commitment to Reuse Indicator

ASSESSMENT QUESTION: At what level in the organization are resources committed to reuse engineering and management?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	No level	Project management is receptive to investing resources on reuse engineering and management to enable reuse within a project when the business case warrants it.	Are considerations and evaluations of domain-specific reuse being factored into post proposal planning activities?	Pre-RFP, pre-proposal, or proposal documentation have business case elements that are reuse-specific.
B	Tactical or Project	Executive level management is receptive to investing resources on domain engineering and management to enable sharing across projects when the business case warrants it.	Are considerations and evaluations of domain-specific reuse being factored into pre-RFP, pre-proposal, or proposal activities?	Business cases supporting strategic planning discuss domain considerations.
C	Domain	Executive level management is receptive to investing resources for product-line reuse engineering and management to enable reuse across products when the business case warrants it.	Are considerations and evaluations of domain-specific reuse being factored into strategic planning activities?	Business cases supporting strategic planning discuss considerations of reuse within the product-line.
D	Strategic or Product-line			

Notes:
(a) The intent of this indicator is to determine to what extent managers and executives have understood and adopted a domain-specific reuse approach to doing business. For this reason, product-line planning is treated as a better case than domain planning. For organizations whose domain is identical to its product-line, the domain scale value is redundant and can be ignored.
(b)This indicator is more important for assessment of projects that whose primary goals are *reuse planning, reuse enactment reuse management,* or *reuse learning* than projects whose primary goal falls into one of the other CFRP families or idioms.

3.2.5 Level of Reuse Advocacy Indicator

ASSESSMENT QUESTION: Who has assumed or been assigned the responsibility for advocating reuse?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	No one	At least one individual believes "reuse is a good idea whose time has come."	Is management receiving suggestions about ways to adopt reuse-based development or about reuse opportunities from at least one individual?	Reviews of cost saving, productivity, or continuous quality improvement suggestions show at least one is related to or requires reuse.
B	Non-management-supported LoneRanger or Team	At least one executive level manager funds one individual or team to explore and promote reuse opportunities.	Has a reuse advocate or project targeted to exploring reuse been proposed during yearly planning?	Lists of candidate tasks include projects to explore the benefits of reuse within a domain.
C	Management-supported LoneRanger or Team	The organization funds establishing and sustaining management of reusable assets and promotion of reuse opportunities.	Does a domain engineering project include funding for establishing and sustaining management of reusable assets produced?	Lists of candidate tasks include domain management projects.
D	Management sponsored and directed	Every individual, as a matter of course, identifies reusable assets at both start (what to reuse) and finish (what may become an asset) of an activity.	Are there communication channels for obtaining, requesting, reporting on and supplying reusable assets and is everyone empowered to use them?	Announcements about the availability of reusable assets are circulated within the organization as well as policy statements or procedures for obtaining, requesting, reporting on and supplying reusable assets
E	Transparent			

Notes:
(a) The intent of this indicator is to measure the degree to which reuse has become an everyday part of doing business. *Transparent* means that need for reuse advocacy has been transcended because reuse is institutionalized.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.2.6 Awareness and Commitment to Process Indicator

ASSESSMENT QUESTION: To what level has the transition to a process driven approach progressed?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Unaware	Some individuals have been exposed to the concepts of a process-driven approach.	Are there requests to attend workshops and training for process?	Training expense reports show expenditures for attendance at workshops and training courses for process.
B	Aware	Some projects are exploring the impact and benefits to the organization.	Is the organization planning projects to experiment with process technology?	Organizational accountability reports show commitment and expenditures of resources for experiments. Status reports shows favorable experiment results.
C	Experimental	The transition has begun and will be phased in systematically.	Are definitions of project processes and guidelines being revised to reflect possible use of reusable assets?	Status reports show inclusion of process steps to identify, evaluate, and integrate candidate reusable assets
D	Introduction	All groups or projects are expected to use it.	Are definitions of project planning processes and guidelines being revised to reflect possible use of and evaluate cost/benefit from reusable assets?	Status reports from the process definition efforts show progress towards defining processes to identify and evaluate reuse opportunities
E	Adoption	Process-driven is now the way the organization conducts its business.	Are processes for domain planning being defined or being revised to consider reuse?	Status reports from the process definition efforts show progress towards defining domain planning processes or show that the revised strategic planning criteria consider reuse.
F	Institutionalization			

NOTES:
(a) The purpose of this indicator is to determine to what extent the notion of process-driven development has been institutionalized within the organization. The scale value roughly parallels the technology adoption curve seen in [9]. This indicator provides the link from the STARS reuse vision to the STARS vision of process-driven. A separate set of indicators is needed to explore the nuances and facets of the process-driven approach.

3.2.7 Reuse Accountability/Effectiveness Measurement Indicator

ASSESSMENT QUESTION: At what level of management are metrics about reuse reviewed and used in planning?				
	SCALE VALUE	GOAL	TRANSITION QUESTION	METRIC
A	None	Project measurement of utilization, management, and creation of reusable assets are collected in response to some unique external request or to spontaneous initiative of project.	Do measurements labeled with reuse appear in project status or final reports?	Status reports show collection of reuse statistics.
B	Ad-hoc Measurement	Project planning guidelines require measurements with respect to utilization, management, and creation of reusable assets are collected and used as input to planning for individual projects.	Are there efforts underway to devise measurements of reuse on application projects?	Project management databases permit collection and analysis of reuse measurements and planning for new projects shows considerations of these measures.
C	Project Planning / Measurement	Measurements with respect to utilization, management, and creation of reusable assets are collected and used as input to domain and strategic planning .	Are there efforts underway to define effectiveness measures for asset creation and/or management ?	Strategic planning processes and guidelines consider reuse measures.
D	Domain Planning / Measurement			

NOTES:
(a) The intent of this indicator is to determine if the organization's management is gathering and using statistics about its implementation and use of a domain-specific, reuse-based approach.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.2.8 Training for Reusing Indicator

ASSESSMENT QUESTION: What materials are used for training in utilization, management, or creation of reusable assets?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None	Reuse advocates provide or arrange presentations or training courses on demand or through offerings in informal, organizational communication paths.	Have there been any presentations promoting awareness that were initiated by reuse advocates?	Status reports from projects or workgroups in the organization mention reuse presentations.
B	Ad-hoc, informal training	Installation, administration, or user guides for tools supporting reuse provide tutorials.	Are there plans for obtaining tools for support of domain-specific reuse and do the criteria for the tool selection include tutorials?	Tool evaluation criteria includes questions about tutorial support.
C	From documentation for reuse-specific tools	Seminars, videos, and training materials developed by external consultants about doing domain specific reuse in general are available	Are there plans for obtaining seminars, videos, or other training materials from outside consultants about doing domain-specific reuse?	Announcement of seminar dates and location or availability of videos and other training materials are circulated in the organization
D	From outside consultants	Seminars, videos, and training materials about domain-specific reuse specifically created or tailored to the organization and its policies are available	Are there plans for obtaining training materials specifically geared to the needs of the organization in doing domain-specific reuse?	Required training courses for reuse use material targeted to the organization.
E	Tailored / Developed to meet Organization specific needs			

Notes:
(a) The intent of this indicator is to determine to what degree the need for training for reuse has been recognized and implemented.

3.2.9 Reuse Process Improvement Indicator

ASSESSMENT QUESTION: How does the organization treat lessons learned from application or domain engineering projects?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Ignores or no formal reviews held	During the course of and after project completion reuse lessons learned are used as input to quality and productivity improvements	Are there on-going quality or productivity improvement efforts?	Recommendations from quality or productivity improvement efforts target 'problem areas' discovered during utilization of reusable assets.
B	Reactive, implements 'workarounds'	Reuse lessons learned are analyzed both within and across projects and alternative solutions are suggested and evaluated relative to long term organizational goals.	Does a management or executive team review recommendations from quality/productivity improvement teams and are there reuse advocates on the review team?	Recommendations from quality or productivity improvement efforts targeting 'problem areas' discovered during utilization of reusable assets are evaluated relative to long term goals.
C	Reflective, considers context and alternatives, implements solutions aimed at root causes			

NOTES:
(a) The purpose of this indicator is to gauge whether the organization is taking advantage of its reuse experience to improve its project processes, guidelines, and policies.
(b) Lessons learned include project metrics, library metrics, asset set effectiveness metrics, heuristics, etc.

3.3 EXPERIENCE WITH DOMAIN-SPECIFIC KNOWLEDGE DIMENSION

The indicators in this dimension are targeted to evaluation of the depth and breadth of the organization's experience within a given domain and with the information and assets that support reuse in a domain. Before assessment proceeds, the domain of interest should be clearly identified along with at least some rules of thumb or an operational definition that permits decisions about what is within the scope of the domain.

The indicators here are particularly useful to gauge what preparatory efforts may be needed before *reuse engineering* projects (asset creation, management, utilization) are undertaken. Ratings showing that the majority of the project staff or workgroup is inexperienced could indicate that pilot or trial use projects are needed before embarking on an actual domain analysis, library establishment, or application development.

If a product-line is designated as the target instead of a given domain, it is necessary to substitute the word "product-line" everywhere "domain" appears in the tables for this dimension (sections 3.3.1 - 3.3.6). And, it may be worthwhile to repeat assessing these six indicators for each domain considered a fundamental part of the product-line. For instance, if the assessment is against the product-line of billing systems for medical services with two fundamental domains of billing insurance companies and of billing uninsured patients, then the assessment might contain six ratings of the project's teams expertise relative to medical billing systems, six ratings of project team's expertise relative to billing insurance firms, and six ratings of the project team's expertise relative to billing of uninsured patients. This increases the number of indicator ratings collected but it provides the opportunity to select more focused goals.

3.3.1 Experience with Building of Systems within this Domain Indicator

ASSESSMENT QUESTION: How experienced is the organization in building systems whose solutions fall totally or partially within this domain?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	No experience and/or none of staff experienced in this domain	At least one team member has been involved with the building of one system within this domain.	Are there any candidate team members currently involved in the building of one system that utilizes this domain?	Resumes, project histories, or personnel records of at least one team member show participation in one relevant project.
B	One System & some staff experienced in this domain	At least one team member has been involved with the building of a few systems that utilize this domain.	Are there any experienced candidate team members currently involved in the building of a system that utilizes this domain?	Resumes, project histories, or personnel records of some team members show participation in a few relevant projects.
C	Two-Three Systems & some staff experienced in this domain	A majority of the team members have been involved with the building of systems that utilize this domain.	Are/ were team members evaluated relative to their experience in this domain?	Resumes, project histories, or personnel records of a majority of team members show participation in a few relevant projects.
D	> 3 Systems & some staff experienced in this domain			

NOTES:
(a) The intent of this indicator is to determine if the project team or workgroup is experienced with this domain. The phrase "been involved with the building of" may mean management of development, development creation, maintenance, or acquisition of. The exact interpretation is specific to the goals and needs of the particular organization being assessed. The meaning of system can range over fielded, of product quality, a prototype, or a pilot. It may be useful to note the particular interpretation(s) used in an assessment.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.3.2 Experience with Domain Model Indicator

ASSESSMENT QUESTION: At what engineering level has the technical team leadership had the opportunity to apply the domain model?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None or Ad-hoc	The technical team leadership has used the domain model to build at least one less than fully functional prototype.	Are there any less than full scale prototypes being built using the domain model?	Status reports from projects show use of the domain model.
B	Used for less than full-scale prototypes	The technical team leadership has used the domain model to build at least one fully functional prototype or used it in a pilot project.	Are there any full scale prototypes being built or pilot projects underway using the domain model?	Status reports from projects show use of the domain model.
C	Used for pilots/ full-scale prototypes	The technical team leadership has used the domain model to build at least one system that is deployed in the field as production quality.	Are there any systems being built for deployment in the field using the domain model?	Status reports from projects show use of the domain model.
D	Used for fielded systems			

NOTES:
(a) The intent of this indicator is to determine what experience the project team has with both the domain knowledge and with domain knowledge encoded in the form of a domain model.
(b) The domain model must exist in some representation other than human memory.
(c) There is a strong, underlying assumption that domain models should be validated in a progression of ever increasing requirements on quality and performance.
(d) "Used" may mean utilization for purposes of acquisition, development, or maintenance. "Full-scale" or "fully functional" means all functionality required for the system is provided. This emphasis on full-scale is to determine the breadth of experience in the domain.
(e) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.3.3 Experience with Reference or Standard Architecture Indicator

ASSESSMENT QUESTION: At what engineering level has the technical team leadership had the opportunity to apply the reference (or standard) architecture?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None or Ad-hoc	The technical team leadership has used the reference architecture to build at least one less than fully functional prototype.	Are there any less than full scale prototypes being built using the reference architecture?	Status reports from projects show use of the reference architecture.
B	Used for less than full-scale prototypes	The technical team leadership has used the reference architecture to build at least one fully functional prototype or used it in a pilot project.	Are there any full scale prototypes being built or pilot projects underway using the reference architecture?	Status reports from projects show use of the reference architecture.
C	Used for pilots/full-scale prototypes	The technical team leadership has used the reference architecture to build at least one system that is deployed in the field as production quality.	Are there any systems being built for deployment in the field using the reference architecture?	Status reports from projects show use of the reference architecture.
D	Used for fielded systems			

NOTES:(a) The purpose of this indicator is to gauge the breadth of experience that the project team has with the existing reference architecture.
(b) The reference architecture must exist in some representation other than human memory.
(c) There is a strong, underlying assumption that reference architectures should be validated in a progression of ever increasing requirements on quality and performance.
(d) "Used" may mean utilization for purposes of acquisition, development, or maintenance. "Full-scale" or "fully functional" means all functionality required for the system is provided. This emphasis on full-scale is to determine the breadth of experience in the domain.
(e) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.3.4 Experience with Set of Domain Components Indicator

ASSESSMENT QUESTION: At what engineering level has the technical team leadership had the opportunity to apply the set of domain components?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None	The technical team leadership has used the domain component set to build at least one less than fully functional prototype.	Are there any less than full scale prototypes being built using the domain component set?	Status reports from projects show use of the domain component set.
B	Used for less than full-scale prototypes	The technical team leadership has used the domain component set to build at least one fully functional prototype or used it in a pilot project.	Are there any full scale prototypes or being built or pilot projects underway using the domain component set ?	Status reports from projects show use of the domain component set.
C	Used for pilots/full-scale prototypes	The technical team leadership has used the domain component set to build at least one system that is deployed in the field as production quality.	Are there any systems being built for deployment in the field using the domain component set ?	Status reports from projects show use of the domain component set.
D	Used for fielded systems			

NOTES:
(a) The purpose of this indicator is to gauge the breadth of experience that the project team has with an existing set of domain components. The set of components may include documents, test cases, source code, or examples for an application generator, or a generator.
(b) There is a strong, underlying assumption that domain component sets should be validated in a progression of ever increasing requirements on quality and performance.
(d) "Used" may mean utilization for purposes of acquisition, development, or maintenance. "Full-scale" or "fully functional" means all functionality required for the system is provided. This emphasis on full-scale is to determine the breadth of experience in the domain.
(e) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.3.5 Effectiveness of Domain Asset Set Indicator

ASSESSMENT QUESTION: Does the domain asset set target the reuse opportunities in this domain?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not effective	For application systems built in this domain, some of their construction involves use of the domain asset set.	Are there demands for access to the domain asset set?	An increasing percentage of projects in this domain request access to/use of the domain set and feedback unmet needs.
B	Somewhat effective	For application systems built in this domain, most of their construction involves use of the domain asset set.	Is use of the domain asset set expected on projects?	All projects in this domain factor use of the domain set into planning and feedback of unmet needs are only in areas where innovation is high.
C	Completely effective			

NOTES:
(a) The intent of this indicator is to uncover whether the project's team experience with the domain engineering products is limited because the set of them is presently inadequate. This indicator is most useful to *reuse planning* projects devising domain and proposal investment strategies.
(b) The domain asset set includes the domain model, reference architecture, domain components, and processes supporting using them. The domain asset set is developed and maintained by a domain engineering effort. It may be managed, brokered, and promoted by a separate asset management effort. (See CFRP section 3.2.2.)
(c) "Use" may mean utilization for purposes of acquisition, development, or maintenance.
(d) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.3.6 Effectiveness of Domain Asset Classifications Indicator

ASSESSMENT QUESTION: Do asset utilizers perceive the domain asset set classifications as effective in aiding them in finding what they need or in learning about the domain?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not effective	The classification scheme incompletely or incorrectly indexes what is available using a domain vocabulary and taxonomy.	Is there any on-going domain engineering effort?	Status reports from domain engineering show progress of domain modeling, where progress is definition of domain model,domain vocabulary, and taxonomy or show validation of same by domain experts.
B	Somewhat effective	The classification scheme completely indexes what is available using a validated domain vocabulary and taxonomy and supports domain understanding by novices	Is there an on-going effort to make the classification scheme more supportive of novices and to reference all assets?	Number of reports of failures to locate appropriate assets is declining.
C	Completely effective			

NOTES:
(a) The purpose of this indicator is to uncover whether the project's team experience with the domain engineering products is limited because locating what is needed is difficult, frustrating,or very time-consuming. This indicator is most useful to *reuse planning* projects seeking to justify investment in an independent, fully-supported domain library. See section 3.4.6 for rating the search and retrieval mechanism.
(b) If there is not any organized way in which assets are classified, then the scale value is "Not Effective".
(c) Reports of failure to find assets must be sifted to determine if the failure is the classification scheme, a poor user interface, or that appropriate assets do not exist. This may involve contacting users.
(d) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.4 USAGE OF TECHNOLOGY FOR REUSE PROCESSES DIMENSION

Technology support is not essential to being reuse-based, but technology support can make reuse processes more productive and more practical. Technology support can facilitate domain modeling and representation, the transfer of domain expertise from experts to novices, and can improve access to assets on a wider scale (more assets or more people).

Technology support can come from general tools supporting software or systems engineering activities or it can be explicitly developed to support a reuse-based activity such as domain modeling. In the tables that follow in this section, general tools are termed **non-reuse based**. Tools developed specifically to support one of the processes found in the *CFRP:Definition* document are termed **reuse-based**. The source of the tool is independent of whether it is reuse-based or not and independent of whether it was STARS-developed or not.

Most of the indicators of this dimension are important for planning and maintaining the infrastructure that supports reuse. We recommend that decisions about what processes are used drive tool selection, not the other way around, which has been the normal situation throughout the 1980's. Also, decisions and details about processes should be used to tailor tools to the specific needs of the organization, rather than an attitude that seeks to make use of the most obscure, sophisticated functionality provided. While individual experimentation or simply "play" with reuse supporting tools and their features is a necessary part of *reuse learning*, suggestions for organization-wide installation should be evaluated as carefully as any other recommendation from any *innovation exploration* or *process evaluation* project or task (See *CFRP:Definition* Section 3.1.3).

3.4.1 Domain Modeling Technology Used Indicator

ASSESSMENT QUESTION: What technology is being used to support domain modeling and analysis?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Pad and Pencil	Domain modeling information is collected and processable on available computing platform.	Do the domain analysts have access to CASE tools?	Domain analysis results are reported as being available on the computing platform in various tool formats.
B	Non-reuse specific tools	Domain modeling information is collected and processable in a format that is directly transferable to computer-assisted asset management.	Are assets being managed by a reuse library mechanism?	Asset management activities report electronic transfer of domain vocabularies, classifications, or other supporting information from domain modeling activities.
C	Domain analysis tools			

NOTES:
(a) The intent of this indicator is to determine how explicitly domain analysis is being supported.
(b) The domain analysis tools should be compatible with , preferably explicitly support, the domain analysis process in use.
(c) It is recommended that tools for domain analysis be selected after the domain analysis process is chosen.
(d) Because domain analysis can also be usefully applied to product-lines since they are families of products, this indicator is also valid if the assessment has a product-line rather than domain focus.

3.4.2 Asset Development Technology Used Indicator

ASSESSMENT QUESTION: How reuse-specific is the technology used to develop reusable assets including software architectures, source code, test plans, etc.?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Programming tools	Support asset utilization with generators and/or automated composers. See Note (b).	Are there on-going efforts to develop and test automated composers or application generators?	Progress reports from pilot and prototyping efforts report success in automating some parts of application development and in having resulting product validated.
B	Non-reuse specific CASE tools	Support asset utilization with generators and/or automated composers.	Are there on-going efforts to develop and test automated composers or application generators?	Progress reports from pilot and prototyping efforts report success in automating some parts of application development and in having resulting product validated.
C	Reuse-specific development tools (e.g. generators, composers)			

NOTES:
(a) The intent of this indicator is determine if the tools used to develop assets are supportive of their utilization as reusable assets in application engineering. For instance, a domain engineer may wish to create an application generator for developing (part-of) user interface, then a meta-generator tool that supported created application generators would be a reuse-specific tool. What is important is that the reuse-specific tool lets the domain engineer express the commonality and variability in a way that makes adaptation by asset utilizers easier and less error-prone than creating the component from scratch.
(b) Use of non-reuse specific CASE tools is not a necessary stepping stone between using programming tools such as compilers and reuse-specific tools. The case is included because many organizations already have and use such tools.

3.4.3 Asset Management Technology Used Indicator

ASSESSMENT QUESTION: What technology is being used to manage domain assets and their descriptions?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None	Assets and their descriptive information are managed by a combination of ad-hoc, informal policies followed by humans and a filing system (computer file system, metal file cabinet, index cards, etc.).	Are there any ongoing activities to put assets under informal management by a system administrator, librarian, or data clerk?	Announcement/ advertisement that access to assets available by contacting a particular person or office.
B	Ad-hoc/ informal database mechanism	Assets and their descriptive information are managed by an automated tool.	Are there any ongoing activities to put assets under management of a database or configuration management tool?	Announcement/ advertisement of access to assets through a known database or configuration management mechanism.
C	Non-reuse specific database mechanism or configuration management system	Assets and their descriptive information are managed by a reuse library tool.	Are there any ongoing activities to put assets under management of a known reuse-specific library mechanism ?	Announcement/ advertisement of access to assets through a known reuse-specific library mechanism.
D	Reuse-specific library mechanism			

NOTES:
(a) The purpose of this indicator is to determine if the data that helps in an asset's reuse is being managed and controlled along with the asset. Anonymous ftp archive sites would be considered to fall under scale value *B*.
(b) Use of non-reuse specific database or configuration management tools is not a necessary stepping stone between using no automated management of assets and reuse-specific library mechanisms. The case is included because many organizations already have and use such tools and may not desire to purchase other software tools.

3.4.4 Asset Qualification Technology Used Indicator

ASSESSMENT QUESTION: What technology is applied to assets in order to assess their reusability or quality when they are put under asset management?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None or Ad-hoc	All assets and the data supporting their utilization are subjected to a filtering process on form before they are accepted for asset management.	Are there any on-going efforts to define asset acceptance criteria based on providing certain categories of data or supplying them in certain formats?	Asset management progress reports definition of asset acceptance criteria or formats to be followed.
B	Criteria on form	All assets and the data supporting their utilization are subjected to a certification process.	Are there any on-going efforts to define asset certification criteria?	Progress reports from asset management report definition of asset certification categories and processes.
C	Criteria on content			

NOTES:
(a) The intent of this indicator is to determine the level of sophistication being applied under asset management to qualify and test the quality of candidate assets. *Criteria on form* means that assets are checked whether they adhere to a pre-defined format that may include information such as who submitted the asset, who created it, when, a point of contact, what tools were used to create it, etc. *Criteria on content* means that assets are qualified by evaluating them with respect to what they purport to implement and/or subjecting them to "-ilities" evaluations. Neither scale value implies the degree of formality or automation used in evaluating the assets.
(b) Whether assets are certified before acceptance into asset management is a policy decision of the organization managing the assets. A minimum recommended policy is to provide a certification level as part of the descriptive information about the assets. One possible level is "not certified/provided as-is."

3.4.5 Asset Classification/Cataloging Technology Used Indicator

ASSESSMENT QUESTION: What technology is used to classify or catalog assets to facilitate their identification for reuse?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	None	Assets are managed by a database or configuration management system.	Is there an on-going effort to manage assets with a database or configuration management system?	Progress reports or announcements from asset management effort report how many assets available from on-line catalog.
B	Ad-hoc	Assets are managed by a reuse library mechanism.	Is there an ongoing effort to manage assets with a reuse library mechanism?	Progress reports or announcements from asset management effort report how many assets available from facet catalog or available for search.
C	Domain concepts based (facets; semantic net; taxonomy)	Assets are managed by a reuse library mechanism *that provides* rule-based processing capability.	Is there an ongoing effort to define data about domain variability in rules?	Progress reports from asset management effort announce availability of rule-based search or selection assistance.
D	Domain commonality / variability based (rule-based)			

NOTES:
(a) The intent of this indicator is to gauge whether the information discovered and documented during domain analysis is available to assist reusers.
(b) Use of non-reuse specific database or configuration management tools is not a necessary stepping stone between using no automated management of assets and reuse-specific library mechanisms. The case is included because many organizations already have and use such tools and may not desire to purchase other software tools.
(c) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.4.6 Asset Identification/Retrieval Technology Used Indicator

ASSESSMENT QUESTION: How are reusers assisted in finding and retrieving candidate assets for reuse?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Browsing	Reusers find and retrieve assets by specifying solution characteristics that are desirable .	Is there an ongoing domain analysis or asset management effort to create facets or a semantic net for components?	Status reports show progress in definition of facets or semantic net and in cataloging assets.
B	Query	Reusers are assisted in their search by rules that distinguish via properties, usage constraints on components.	Is there an ongoing domain analysis or asset management effort to create a rule base from data about implementation characteristics of or constraints on using components?	Status reports show progress in definition of rules and of successful identification and retrieval.
C	Implementation-directed (rules about components)	Reusers are assisted in their search by rules that distinguish via properties and constraints of the reference solution architecture.	Is there an ongoing domain analysis or asset management effort to create a rule base from data about characteristics of or constraints on using a reference solution architecture?	Status reports show progress in definition of rules and of successful identification and retrieval.
D	Solution-directed (rules about architecture)	Reusers are assisted in their search by rules that distinguish via properties and constraints of the problem domain.	Is there an ongoing domain analysis or asset management effort to create a rule base from data about characteristics of or constraints on requirements or problem entities?	Status reports show progress in definition of rules and of successful identification and retrieval.
E	Requirements-directed (rules about problem)			

NOTES:
(a) The intent of this indicator is to determine to what degree potential reusers must be familiar with the concepts, constraints, and vocabulary terms of "the solution" as well as familiar with the concepts, constraints, and vocabulary terms of " the problem" in order to find and retrieve assets.

(See *CFRP:Definition* Section 3.2.1). The technology used may provide more than one search method. For the purposes of assessment, it would suffice to use the best value obtained. If more than one organization is involved, it may be useful to record a rating for each separately and then the candidate goals can be targeted to improving the organizations with the lower ratings.
(b) *Browsing* may be through an on-line index that is textual or graphically displayed or a paper catalog. That is, browsing does not presuppose a degree of automation, just a degree of organization. In fact, the capability to browse is independent of the classification method (way assets are organized, e.g.; taxonomy, facets, semantic net, etc.). Browsing is also one way potential reusers can informally learn about a domain asset set independent of searching for an asset to met particular needs or constraints.
(c) Search by *query* means that the potential reuser specifies certain characteristics or conditions that a candidate asset must have and is given back a, possibly empty, list of components that exhibit those characteristics and conditions. Query languages for relational databases simplify querying asset libraries built using them. The drawback to search by query is that a potential reuser must know what characteristics and conditions are needed, what attributes store these characteristics, if any, and what values, if any, represent them in the database. Domain engineering expertise that could help decide the right set of characteristics and conditions is not available although it may have been gathered during domain analysis.
(d) *Implementation-directed* search means the search mechanism uses heuristics that help a potential reuser select among implementation characteristics or conditions on assets. Implementation characteristics for code assets run a gamut of such information as what organization developed an asset to what compilers to whether the algorithm presumes a limit on the number of data items it manages or evaluates over. Implementation characteristics for non-code assets run a similar gamut.
(e) *Solution-directed* search means the search mechanism uses heuristics that help a potential reuser find assets that fit into or support instantiating a particular reference architecture. The heuristics help the potential reuser select assets whose commonalities and variabilities are sufficient and consistent with the architecture and compatible with each other.
(f) *Requirements-directed* search means the search mechanism uses heuristics that help a potential reuser find assets using the vocabulary and concepts intrinsic to the problem. The heuristics help the potential reuser select a set of assets that make up one member of the family of systems in that domain. For instance, if the domain analysis found that one intrinsic variation in the requirements for systems in the domain was the trade-off between speed and accuracy in calculating a certain value, a requirements-directed search would help the user find assets that implemented the desired trade-off. That is, in this case, the interaction between the potential reuser and the search mechanism would use the name of the calculation and designate speed and accuracy values, but would not use implementation or solution details such as the name of the algorithm used for multiplication or what the communication architecture will be.
(g) The scale values *B* through *E* all presume that the search method will be an interaction between the potential reuser and a computerized asset library. Scale values *C* through *E* may be thought of as dialogues between the potential reuser and the computerized asset library. Such dialogue-directed searching has been implemented through the use of knowledge-based technologies. In particular, both the Paramax asset library mechanism, Reuse Library Framework (RLF), and the Boeing asset library mechanism, Reusable Object Access and Management System (ROAMS), use knowledge-based technology to support dialogue-directed searching. For RLF and ROAMS, the level of the dialogue depends upon the abstraction level of the domain model encoded in the asset library.

3.4.7 Asset Tailoring/Integration Technology Used Indicator

ASSESSMENT QUESTION: What technology is provided to assist reusers in tailoring assets or applying domain knowledge?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	General software development tools	Reusers are assisted in tailoring assets by supplying variables or filling in templates.	Is there an ongoing asset creation effort to define templates or generics for this domain?	Status reports show progress in definition of generics and templates and in their validation.
B	Component-level (generics, templates)	Reusers are assisted in tailoring assets by supplying variables that are used across components.	Is there an ongoing asset creation effort to define "make" files for assets selected from this domain?	Status reports show progress in definition of "make" files and in their validation.
C	Architecture-level (make)	Reusers are assisted in tailoring assets by writing specifications or making decisions.	Is there an ongoing asset creation effort to define application generators or create automated composers for this domain?	Status reports show progress in definition of application generators or automated composers and in their validation.
D	Requirements-level (automated composers, application generators)			

NOTES:
(a) The intent of this indicator is to determine to what degree potential reusers must be familiar with the concepts, constraints, and vocabulary terms of "the solution" as well as familiar with the concepts, constraints, and vocabulary terms of "the problem" in order to adapt or tailor assets to the particular needs of a system.
(b) There is not a required progression from providing general software development tools through generics and templates, make files, to application generators and automated composers. The scale was arranged to reflect somewhat the degree of software engineering knowledge needed to effectively tailor the assets. That is, the scale assumes using general software development tools requires much more software engineering expertise than using an application generator. The choice of goal here will also depend on availability of supporting technology and breadth and depth of domain expertise available.
(c) There is a correlation between the scales for the asset identification/retrieval technology used indicator and this one. The abstraction level needed in a domain model used to support the various levels of dialogue-directed search corresponds to the abstraction level needed for *B*, *C*, and *D* here.

3.4.8 Integration of Tools and Processes Indicator

ASSESSMENT QUESTION: To what degree do the tools provided support the processes for reuse?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not at all	Reuse process definitions have been analyzed to identify general automation support or capabilities needed and those needs have been used to select general purpose tools.	Is the organization responsible for tool support requiring that tool requests identify what activities they are to support?	The cost/benefit analysis for capital expenditures includes a section on the activities to be supported.
B	Somewhat -- general tools provided	Reuse process definitions have been analyzed to identify reuse-specific automation support or capabilities needed and those needs have been used to select general reuse tools.	Is the organization responsible for tool support requiring that tool requests identify what processes needs they satisfy?	The cost/benefit analysis for capital expenditures includes a section on the process needs to be satisfied.
C	Mostly -- supports general reuse activities and concepts	Reuse process definitions have been analyzed to identify reuse automation support or capabilities needed for a specific domain and those needs have been used to tailor or develop reuse tools.	Is the organization responsible for tool support requiring that tool requests identify what processes needs they satisfy and what domain they support?	The cost/benefit analysis for capital expenditures includes a section on the process needs to be satisfied and of the domain to be supported..
D	Explicitly tailored/ developed for domain-specific reuse processes			

NOTES:
(a) The purpose of this indicator is to gauge to what extent the technology infrastructure has been adapted to support reuse processes, where reuse processes are those identified in the STARS CFRP in the families of reuse planning, reuse enactment, asset creation, asset management, asset utilization, and reuse learning.
(b) Domain-specific reuse processes are reuse processes tailored to the needs of specific domains.
(c) Since tools and technology can constrain what processes are used, we strongly recommend that tools be acquired or adapted to fit the process, not the other way around.

3.5 BUSINESS CLIMATE & REUSE MANAGEMENT DIMENSION

Three indicators that follow *(Costing/Pricing, Legal, Contractual)* are just a few of the many business related factors that can affect whether reuse is a benefit to an organization. Organizations should feel free to tailor this dimension to their particular way of doing business.

The other three indicators specifically raise issues about reuse management.

3.5.1 Costing/Pricing Indicator

ASSESSMENT QUESTION: What is the basis for estimating and allocating reuse costs for a particular project?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Ad-hoc	Costs are estimated and allocated based on previous project experience in this domain.	Are reusage and project metrics being collected?	Reusage and project metrics are used in estimating new projects or in allocating costs of reuse infrastructure development.
B	Based on previous experience	Costs are estimated and allocated based on previous project experience in this domain and on forecasts of what is available for reuse.	Is there an effort underway to provide visibility into the domain asset set for pre-proposal or pre-RFP activities?	Estimates of project costs are based on a study of what is probably applicable to the new project from the existing asset base.
C	Based on experience and asset base usage forecast			

NOTES:
(a) The intent of this indicator is to determine if reuse costing has been integrated into the management of projects.
(b) Reusage metrics report on use of reusable assets or participation in domain quality improvement efforts.
(c) Reuse costs cover costs incurred in creating, managing, or utilizing reusable assets in this domain. If the assets are purchased rather than created, that is also a cost. Asset management also includes a brokerage role whose costs may be allocated across projects and/or organizations. Reuse overhead costs such as those incurred during reuse management (see *CFRP: Definition* Sections 3.1.1 - 3.1.3) may also be counted as reuse costs.
(d) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.5.2 Legal Indicator

ASSESSMENT QUESTION: Have the data rights issues that hinder reuse been resolved?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Data rights issues unresolved	Issues resolved	Are negotiations underway or data rights policies being revised or defined to allow reuse?	Status reports show progress.
B	Data rights issues resolved			

NOTES:
(a) The purpose of this indicator is to determine if data rights issues have been raised and are being addressed.
(b) Depending upon organizational policies or goals, these may be general data rights or specific to the domain or product-line.

3.5.3 Contractual Indicator

ASSESSMENT QUESTION: How do contracting policies affect reuse?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Reuse disincentivized	Contracting policies hindering reuse are removed.	Are negotiations underway or are contracting policies being revised or defined to allow reuse?	Status reports show progress.
B	No benefit from reuse	Contracting policies and procedures encourage reuse.	Are negotiations underway or are contracting policies being revised or defined to encourage or reward reuse?	Status reports show progress.
C	Reuse incentivized	Contracting policies and procedures require reuse.	Are negotiations underway or are contracting policies being revised or defined to penalize non reuse?	Status reports show progress.
D	Reuse assumed			

NOTES:
(a) The purpose of this indicator is to gauge whether contractual issues have been examined and are undergoing change that creates an expectation that reuse is a normal, desirable part of the way business is conducted.
(b) Moving from encouraging reuse to requiring reuse may not be desirable for domains that are not well understood or have a high rate of innovation or volatility.
(c) Contracting policies may be internal as well as external.

3.5.4 Domain Management Indicator

ASSESSMENT QUESTION How are domains managed?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not at all	Domains are managed on a project by project opportunity basis.	Have the relevant domains for the organization been identified and defined?	Strategic plans identify specific domain engineering efforts to be undertaken.
B	Adhoc	Each domain is managed by a domain management plan.	Is there an on-going domain engineering effort?	Status reports from the domain engineering effort show progress in developing a business case and management plan.
C	By domain management plan	Each domain management plan is coordinated with an overall business strategic plan.	Have business plans begun to identify and prioritize domain engineering efforts?	Product line plans reference domain management plans and business cases.
D	By integration with strategic plan			

NOTES:
(a) The intent of this indicator is to determine if domain considerations have been integrated into the overall business planning and management.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table. For those organizations where the product line and domain are identical, scale value C is the best case.

3.5.5 Domain Support Indicator

ASSESSMENT QUESTION How are domains supported?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not at all	Reuse of already existing parts of good quality.	Is there an on-going effort to build a reuse library from existing artifacts?	Reuse library publishes a catalog of parts.
B	By reuse library built by extracting from previous work	Each domain is supported by a reuse library or other infrastructure to manage, broker, and enable utilization of domain specific assets.	Is there an on-going domain engineering effort?	Status reports from projects show use of domain-specific library and infrastructure.
C	Through domain-specific library and infrastructure			

NOTES:
(a) The purpose of this indicator is to determine if there is or has been any investment in building up the domain asset set and the infrastructure that supports its use. For organizations that mainly acquire systems or maintenance, this indicator has little importance for those domains in which the systems are acquired. However, it can have importance if the domain is covers one or more of their business processes. For instance, a reuse library of adaptable "boiler plate" for RFPs, contracts, requirements, etc. along with software to support adaptation could be very productive. In such a treatment, the products (RFPs, etc.) of the organization are treated as a product-line whose customers are the contractors who supply systems. This follows a fundamental emphasis of CQI/TQL/TQM to work to better serve or increase the satisfaction of your customers.
(b) Scale value B is an intermediate, but not required case between the other two values. Some organizations have used this approach successfully.
(c) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

3.5.6 Domain Learning Indicator

ASSESSMENT QUESTION How are domain engineering products evaluated during/after use and suggestions for their evolution formulated ?				
SCALE VALUE		GOAL	TRANSITION QUESTION	METRIC
A	Not at all, haphazardly	Suggestions for improvement are explicitly solicited from the users of the domain engineering products relative to problems they encountered this time.	Does domain management solicit problem reports?	Status reports from domain engineering summarize problems and their resolution.
B	Reactive -- Relative only to current use, problems	Suggestions for improvement are explicitly solicited from the users of the domain engineering products relative to problems they recently and in the past encountered and relative to new technology and ideas.	Does domain management solicit suggestions?	Status reports from domain management show receipt of suggestions.
C	Reflective -- relative to current and past use & new technology or ideas			

NOTES:
(a) The intent of this indicator is to determine if the processes used for the range of activities from development through management, independent of the role or status of the individual in the organization, explicitly promote and/or provide extra time for reflection that improves the domain engineering products or processes. (See Section 3.1.3 *CFRP:Definition.)* That is, are individual members of the project team, regardless of role, encouraged to take time to document insights on the fly or to reflect on current or previous experience for improvement suggestions? Group/team brainstorming/debriefing sessions at the close of a project constitute promotion or encouragement as long as the results are feed into the next round of planning. Two techniques that help sustain individual domain learning are: (1) To report to the individual/group who suggested the improvement its dispensation and the rationale.(2) To provide readily accessible communication paths for sharing of on-the-fly insights via electronic means such as mailers, bulletin boards, or newsgroups. Consideration should also be given to explicit scheduling of "play time" to explore new techniques or ideas.
(b) If the assessment is based on a product-line rather than a domain, substitute the word "product-line" for "domain" in the table.

4. USING THE RSM

This section follows a general outline for process descriptions that first explains what information is needed to get started, then describes the product or results expected from the activity, describes a procedure that can be used to accomplish the process, and finally explains how the activity or results may interact with other activities or products.

4.1 Getting Started

Objectives: It is assumed that the objective of using the RSM is to develop a set of goals to be integrated into a project plan to further the transition to a domain-specific, reuse-based approach and organizational context. Further, it is assumed that this objective can be met by:

1. using the RSM indicator tables is to assess the current state and context of reuse practice that a particular project team will experience, which is called the RSM profile;
2. using the RSM profile to identify candidate goals and associated metrics, which is called the initial goal set;
3. using the precedence and similarity tables to ensure continuity, consistency and remove redundancies from the initial goal set to form the candidate goal set;
4. using business constraints, strategies, context, and resource limits to prioritize the candidate goal set;
5. using the prioritized candidate goal set to select the high priority goals to be used by a project; and,
6. integrating the selected goals and associated metrics set into the overall project plans and its management.

Information Needs: Before beginning an assessment, the organization involved and domain of interest must be clearly identified. The organization can range from a particular project team up to an industry or enterprise. The domain must be sufficiently defined so that it is not difficult to decide what is within the scope of the domain and what is outside it. Depending upon the complexity of the domain, it may be beneficial to treat it as a product line and its subdomains as full fledged domains in themselves. Such treatment will require extra steps to be taken to formulate a strategy that considers all domains in the context of the product-line to ensure optimization from the product-line's perspective.

It is also helpful to have at hand any relevant business planning or strategy material of importance to the parent organization and/or, a list of the organization's business objectives for the project.

In the context of the process categories found in the *CFRP:Definition* Section 3.1.1, it is assumed that the products of *direction setting* and *domain selection* are available as input. To borrow terms from the SPC's Domain Engineering Guidebook [12], these products include a list of top-level domain assumptions about commonality and variability, a domain synopsis that is a summary definition of the primary concepts, functions, and interactions for the domain, and a domain status that is an overview of relevant business issues such as economic viability of the domain or technology directions and trends.

Expertise Needed: The individual(s) will need a familiarity with the STARS vision of reuse as articulated in the CFRP documents [1,2]. In addition, knowledge of the business culture, plans, and policies of the organization is useful.

4.2 Product Description

The final product of this activity is a list of project goals and the metrics used to assess progress towards realizing them. Several interim products are produced along the way including an RSM profile, the initial goal set, and the RSM candidate goal set. A description for each interim and the final product is given below in terms of purpose, content, form/structure, and verification criteria.

RSM PROFILE (INTERIM)

Purpose: The purpose of the RSM profile is to document the ratings and notes of the assessment.
Content: The assessed scale value and possibly rationale for each indicator.
Form and Structure: A suggested format to collect the rating (and other material) for each indicator is shown as section 4.5. A suggested format for summarizing the ratings on a few pages is shown as section 4.6. The forms are simply suggestions. Each organization should feel free to develop their own.
Verification Criteria: None.

INITIAL GOALS AND METRIC SET (INTERIM)

Purpose: The purpose of the initial goals and metric set is to identify goals that the assessment ratings indicate may be reasonable to impose as goals and measures for assessing progress against them on the project.
Content: The goals on the same row as the indicator ratings and in rows below. If the rating is "best case," no goals or metrics are provided, although the organization may wish to define a goal and progress metric for sustaining "best case."
Form and Structure: The goals and metrics can be added to the form used to document each indicator in section 4.5.
Verification Criteria: None

CANDIDATE GOALS AND METRIC SET (INTERIM)

Purpose: The purpose is to apply some evaluation criteria to make sure the goals are consistent and non-redundant and to assign them priorities based upon business plans and strategies.
Content: Goals, metrics, and priority assignments.
Form and Structure: Indication of which goals and metrics are candidates as well as priority assignments can be added to the form used to document each indicator in section 4.5.
Verification Criteria: See section 2.4.2.

SELECTED GOAL AND METRIC SET (FINAL)

Purpose: The purpose is to select the actual goals to be used on the project from the prioritized candidate goals and metric set and to adapt and implement their associated progress metrics for use on the project.
Content: Goals and metrics.
Form and Structure: The format should follow the policies and guidelines of the organization for describing goals and metrics.
Verification Criteria: The goals and metrics should be verified using the policies and guidelines of the organization for evaluating the reasonableness of project goals and measures.

4.3 Process Description

Brief descriptions of a procedure for developing the RSM profile and selected goal and metric set follows. For each step in the procedure, there are heuristics that suggest techniques or data that make the step more effective. Overall heuristics and guidelines are provided in section 2.4.

Procedure:

Step 1:. Determine organization(s) and domain of the project and characterize primary project goal(s) with respect to CFRP families and / or idioms.

Heuristics: If one individual is applying the RSM, it may be helpful to begin a folder or notebook (electronic or paper), in which the first material contains a date, a short project description of purpose and duration, succinct descriptions of the domain or product-line of interest and of the organization(s) involved, and an assignment of the primary project goal with respect to the CFRP families and/or idioms. It would be useful to keep copies of the input domain assumptions, synopsis, and status (or their equivalents) in that folder or notebook, too. If the assessment is being done by a team of individuals, one person should be designated to manage and disseminate this information for the team.

Risk Management: Risks can arise from not providing sufficient detail in the description of the domain, product-line, or organization(s) to permit consistent decisions about what is in or out of scope of the domain, product-line, or organization. The simplest way to mitigate this risk is to have the descriptions reviewed. Risk can also arise from a mis-assignment of the project's primary goal relative to the CFRP. This is not a serious risk since the only reason for assignment is to resolve conflicting points of view. If disagreement arises about the assignment, it indicates that the individuals involved have different interpretations or understanding of the CFRP which should be resolved at a later time.

Step 2: Conduct assessment and perform goal and metric identification for each indicator by reading the assessment question and the scale short descriptions and selecting one. Selecting one may require reading the goals associated with transitioning to the next state and the notes. Remember that the goal in one row describes the realization of the scale value on the succeeding row. The goals and associated metrics in the same row as the scale and all succeeding rows in that table.

Heuristics: What makes this effective is to collect the issues, agreements, definitions, and rationale as well as the rating because the issues can be used later in later steps to evaluate and prioritize. In a team setting, round robins with the minority opinions used to stimulate discussion have been used effectively.

Risk Management: Risks arise from too high or too low a rating for an indicator with the too low rating being less serious. The risk of too high a rating is that the importance of applying effort to better the rating of the indicator will be misunderstood or that effort will be applied towards a premature goal. The risk of too low a rating is that either the assessment team will be demoralized or that the project team will become overconfident when the goal is so trivial to meet. Experience doing the assessment and understanding of the CFRP will lessen the risk.

Step 3: Evaluate and prioritize identified goals relative to project context and constraints. The initial goals need to be evaluated relative to the consistency and redundancy checks given in section 2.4.2 and relative to what is reasonable to accomplish within the project's context, particularly by selecting one goal for those indicators that may have identified a set of possibilities. Once the initial set has been winnowed to the candidate set, each candidate goal should be assigned a priority.

Heuristics: The evaluation of candidate strategic elements should follow the organization's policies, procedures, and processes for strategic planning if they are familiar. In addition, there is a variety of group evaluation processes from continuous quality improvement methods that could be applicable. For instance, there is a method that rates the ability, the impact, the leverage, and the degree of control that the group believes it has in implementing a goal. Furthermore, an evaluation process for the strategic elements should consider them in the context of the organization's long term strategy or mission. One question that might be asked is to evaluate the candidates in the context of the organization's identified core competencies either to extend them or improve them.

Risk Management: Risks arise from assigning to a goal a priority that is too high or too low resulting in a less than optimal plan. Since there are many other reasons that can make a plan less effective or even obsolete, this risk can most likely be ignored.

Step 4: Select highest priority reuse goals, tailor progress metrics, and integrate into project plans. The technique used to select the highest priority goals and tailor metrics should follow the criteria and policies of the organization.

Heuristics: Tailoring and adaptation of the progress metrics should strive to minimize the impact on the organization and on the project team from metric collection. For examples of metrics that have been used by a commercial organization to measure the organizational facets of reuse see [11].

Risk Management: The majority of the risk associated with this step is the same risk associated with any business or project planning. Whatever risk management techniques are routinely used by the organization for business planning should also be applied here There is also some risk that if the metric collection is perceived as a burden, the values will not be collected will not be accurate or sufficient for reliably drawing conclusions about improvement or for forecasting.

4.4 Interactions with Other Activities

The information and results from this activity should be feed back into the main line of project planning and to whatever management entity(ies) coordinating projects, setting overall business or product-line strategies, or managing the domain involved. This information must be used to set up the schedules for review of progress, etc. The information is also valuable for continuing business planning or to projects starting at a later time.

4.5 Sample Worksheets

4.5.1 Suggested worksheet for each indicator

The worksheet provides space to enter the indicator name, the scale value assigned, the rationale for assigning that rating. And then for each possible goal (up to 6), space is provided to indicate on the first round if that goal was possible (initial), was selected as a candidate after evaluating relative to project constraints and context and precedence/redundancy rules, extra space labeled other,priority assigned, and the rationale for assigning the priority value.

The worksheet should be treated as merely a suggestion. Each organization may find it desirable to devise their own. Another suggestion is that rationale/reasons be assigned some kind of code if there seems to be repeat uses of the same rationale. In which case, the space allotted in the worksheet can be made smaller and the coded rationale/reasons can be documented in another way.

INDICATOR
SCALE VALUE ASSIGNED:
RATING RATIONALE:

GOAL	INITIAL CHOICE (Y OR N):	CANDIDATE (Y OR N):	PRIORITY	OTHER	RATIONALE FOR PRIORITY
A					
B					
C					
D					
E					
F					

4.5.2 Suggested worksheet for summary of RSM Profile

The workshop provides spaces to mark the rating for each indicator, annote the rating with a code number or letter pointing to the relevant rationale if it was collected, to put a Y or N to indicate if that indicator was selected for the one of the project goals, and give the priority assigned to the indicator.

The columns across the top are:

- Indicator number (put "3." in front to locate appropriate indicator section),
- Indicator name,
- Ratings (up to six columns),
- Rationale code #,
- Selected (Y or N),
- Priority.

The ratings are grouped as up to six columns with those unneeded for an indicator blacked out. The idea is to circle or put an X in the scale value assigned. If an assessment is done at the beginning of the project and then another is done at the end of the project, one rating can be overlaid on top of the other with a transparency to graphically show the difference.

SUMMARY PROFILE - Part 1											
#	**DOMAIN :** **ORGANIZATION:** **PROJECT CATEGORY:** **INDICATOR**	**RATING**						**RATIONALE #**	**SELECTED**	**PRIORITY**
DOMAIN STABILITY DIMENSION (section 3.1)										
1.1	Domain Age	A	B	C						
1.2	Volatility	A	B	C	D	E				
1.3	Domain Model(s) Existence	A	B	C	D	E				
1.4	Standard or Reference Architecture Existence	A	B	C	D	E				
1.5	Supported off-the-shelf components available	A	B	C	D	F				
ORGANIZATION READINESS DIMENSION (section 3.2)										
2.1	Motivation for Reuse	A	B	C	D	E	F			
2.2	Scope of Planning for Reuse	A	B	C	D	E	F			
2.3	Identification of Reuse Opportunities	A	B	C	D	E				
2.4	Management Commitment to Reuse	A	B	C	D					
2.5	Level of Reuse Advocacy	A	B	C	D	E				
2.6	Awareness/Commitment to Process	A	B	C	D	E	F			
2.7	Reuse Accountability/Effectiveness Measurement	A	B	C	D					
2.8	Training for Reusing	A	B	C	D	E				
2.9	Reuse Process Improvement	A	B	C						
EXPERIENCE WITH DOMAIN -SPECIFIC KNOWLEDGE DIMENSION (section 3.2)										
3.1	Experience with building systems that use this domain	A	B	C	D					
3.2	Experience with domain model	A	B	C	D					
3.3	Experience with reference or standard architecture	A	B	C	D					
3.4	Experience with set of domain components	A	B	C	D					
3.5	Effectiveness of domain asset set	A	B	C						
3.6	Effectiveness of domain asset classifications	A	B	C						

SUMMARY PROFILE - Part 2											
#	**DOMAIN** **ORGANIZATION:** **PROJECT CATEGORY:** **INDICATOR**	**RATING**						**RATIONALE#**	**SELECTED**	**PRIORITY**
USAGE OF TECHNOLOGY FOR REUSE PROCESSES DIMENSION (section 3.4)										
4.1	Domain Modeling Technology Used	A	B	C						
4.2	Asset Development Technology Used	A	B	C						
4.3	Asset Management Technology Used	A	B	C	D					
4.4	Asset Qualification Technology Used	A	B	C						
4.5	Asset Classification/Cataloging Technology Used	A	B	C	D					
4.6	Asset Identification/Retrieval Technology Used	A	B	C	D	E				
4.7	Asset Tailoring/Integration Technology Used	A	B	C	D					
4.8	Integration of Tools with Processes	A	B	C	D					
BUSINESS CLIMATE & REUSE MANAGEMENT DIMENSION (section 3.5)										
5.1	Costing/Pricing	A	B	C						
5.2	Legal	A	B							
5.3	Contractual	A	B	C	D					
5.4	Domain Management	A	B	C	D					
5.5	Domain Support	A	B	C						
5.6	Domain Learning	A	B	C						

4.6 Worked Examples

4.6.1 Example using indicator worksheet

The example worksheet is filled in with purely fictitious data just as a point of illustrating what could be various reasons/rationale and to show why formulating a strategy involves evaluation of the entire set of possible goals for an indicator.

2.7 Reuse Accountability/Effectiveness Measurement INDICATOR
SCALE VALUE ASSIGNED: **B -- Adhoc**
RATING RATIONALE: **Reason 27** -- Percent of lines of code reused without modification reported to fulfill special request of customer.

GOAL	INITIAL CHOICE (Y OR N):	CANDIDATE (Y OR N):	PRIORITY	OTHER	RATIONALE FOR PRIORITY
A					
B					
C	**Y**	**N**		(see note)	
D	**Y**	**Y**	**H**		**Domain implementation plan recently completed. Want to stimulate accountability to that plan**
E					
F					

Note: Precedence of goals (see Table 1) shows need for domain asset set as prerequisite.

4.6.2 Example using profile worksheet

The example is made from purely fictitious data. The assumptions on which the example is built include:

a. An industry standard reference architecture recently was adopted after several years effort.
b. Several competitors sell application interfaces and sets of components in the domain but not fully implement the reference architecture.
c. The goal of the project will be to implement a fully, compliant set of components to reach market first.
d. The first product of the company will be the fully, compliant set of components.

DOMAIN: Communications/control of passenger entertainment systems built into seat backs on commercial airplanes.

ORGANIZATION: Sit,Look, and Listen, Inc., start-up software company.

PROJECT CATEGORY RELATIVE TO CFRP: *Asset Creation*.

SUMMARY PROFILE - Part 1

#	**DOMAIN** :communications and control for passenger entertainment systems in airplanes **ORGANIZATION:** Sit,Look, and Listen,Inc. **PROJECT CATEGORY:** Asset Creation **INDICATOR**	**RATING**						**RATIONALE#**	**SELECTED**	**PRIORITY**
	DOMAIN STABILITY DIMENSION (section 3.1)									
1.1	Domain Age		B	C				1		L
1.2	Volatility		B	C	D	E		2,4	A	L
1.3	Domain Model(s) Existence		B	C	D	E		2,4	A	H
1.4	Standard or Reference Architecture Existence		B	C	D	E		2,4	B	L
1.5	Supported off-the-shelf components available		B	C	D	E		3,5	A	L
	ORGANIZATION READINESS DIMENSION (section 3.2)									
2.1	Motivation for Reuse		B	C	D	E	F	13	E	M
2.2	Scope of Planning for Reuse		B	C	D	E	F	6	C	M
2.3	Identification of Reuse Opportunities	A		C	D	E		9	B	M
2.4	Management Commitment to Reuse	A		C	D			10	C	H
2.5	Level of Reuse Advocacy	A	B		D	E		11	C	M
2.6	Awareness/Commitment to Process	A		C	D	E	F	12	B	M
2.7	Reuse Accountability/Effectiveness Measurement		B	C	D			27	C	H
2.8	Training for Reusing	A	B		D	E		21	C	M
2.9	Reuse Process Improvement	A		C				26	A	M
	EXPERIENCE WITH DOMAIN -SPECIFIC KNOWLEDGE DIMENSION (section 3.2)									
3.1	Experience with building systems that use this domain	A	B		D			7	B	M
3.2	Experience with domain model		B	C	D			7	A	M
3.3	Experience with reference or standard architecture		B	C	D			16	A	H
3.4	Experience with set of domain components		B	C	D			8	A	H
3.5	Effectiveness of domain asset set		B	C				15	A	L
3.6	Effectiveness of domain asset classifications		B	C				22	A	L

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SUMMARY PROFILE - Part 2											
#	**DOMAIN** :communications and control for passenger entertainment systems in airplanes **ORGANIZATION:** Sit,Look, and Listen,Inc. **PROJECT CATEGORY:** Asset Creation **INDICATOR**	**RATING**						**RATIONALE#**	**SELECTED**	**PRIORITY**
USAGE OF TECHNOLOGY FOR REUSE PROCESSES DIMENSION (section 3.4)										
4.1	Domain Modeling Technology Used		B	C				20	B	H
4.2	Asset Development Technology Used	A		C				26	B	L
4.3	Asset Management Technology Used		B	C	D			21	A	L
4.4	Asset Qualification Technology Used		B	C				21	A	L
4.5	Asset Classification/Cataloging Technology Used		B	C	D			21	A	L
4.6	Asset Identification/Retrieval Technology Used		B	C	D	E		21	A	L
4.7	Asset Tailoring/Integration Technology Used		B	C	D			21	A	L
4.8	Integration of Tools with Processes		B	C	D			21	A	L
BUSINESS CLIMATE & REUSE MANAGEMENT DIMENSION (section 3.5)										
5.1	Costing/Pricing		B	C				24	A	M
5.2	Legal		B					23	A	M
5.3	Contractual		B	C	D			23	A	M
5.4	Domain Management	A		C	D			8	C	H
5.5	Domain Support		B	C				28	C	M
5.6	Domain Learning		B	C				5	A	M

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